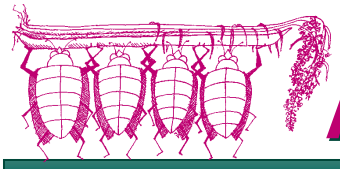
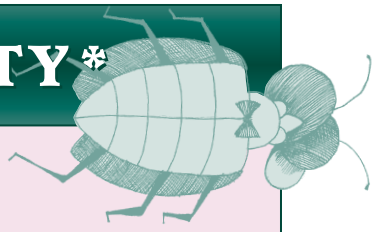


ACTIVITY 3 GRADES 6-12

BEAN BIODIVERSITY*



Objectives

- Students will be familiar with the concept of biological diversity (biodiversity) and why it is important.
- Students will describe how diversity can be measured and expressed with a mathematical index.
- Students will understand how useful a non-biological model can be in describing biological processes.
- Students will understand the effect an invasive species such as purple loosestrife can have on diversity in the biological community it invades.

Time Requirement

45-minutes.

Wisconsin Model Environmental Education and Science Standards

Environmental Education: A.8.1, A.8.4, A.8.5, A.8.3, B.8.3, C.8.2, D.8.6, A.12.1, B.12.3, B.12.6, B.12.7. *Science:* C.8.2, C.8.3, C.8.11, F.8.8, F.8.9, C.12.4, C.12.5.

DESCRIPTION

Students use an index model to assign numerical values to the biological diversity of a given habitat.

PROBLEM

How can various biotic communities (or a community changing over time) be compared in terms of biological diversity?

MATERIALS

(To be distributed to each student or each small group)

- ❑ Several assorted, dry seeds (beans).
- ❑ Paper lunch bags.

PREPARATION

Prepare one bag with assorted seeds for each group or for each group of students. Each bag should contain 30 seeds of at least five different kinds. Read and discuss the background information with the students.

PROCEDURES

1. Each student or small group should get a paper bag of assorted seeds.
2. Assign a wetland plant name to each seed type, making sure to name one of the seeds purple loosestrife.
3. Ask students to begin removing seeds from their habitat bag, randomly, one at a time. Using letter symbols for wetland plant names, record your results. Remove 30 seeds. Results should look something like this: LLCCSJJL…
4. Have students calculate the Diversity Index of their habitat bag and record the number.

   Diversity Index = (number of runs) / total number of plants

   The number of runs is the number of groups of the same plant found consecutively in your random drawing. Another way of stating the number of runs is that it is equal to the number of times that you encounter a change in the kind of plant

Activity 3. BEAN BIODIVERSITY

seed as you move through the sequence. In order to determine the number of runs, draw a line above or below, in alternating fashion, each identical letter that appears consecutively, like this:

L̲L̲C̅C̅S̲J̅J̅L̲

In this example there are 5 runs for 8 plants. Diversity Index = 5/8 = 0.625

5. Each small group should be given additional purple loosestrife seeds. For every purple loosestrife seed added, randomly remove one of the other seeds, mimicking the displacement that is said to occur when purple loosestrife invades.

6. Repeat steps 3 and 4.

BACKGROUND INFORMATION

One of the major problems with the increase of purple loosestrife in North American wetlands, often cited by researchers and resource managers, is that it tends to crowd out other native wetland plants. If this happens, loosestrife becomes more important in the functioning of the community and many kinds of plants it replaces become less important in the system. Gradually the number of different kinds of plants in the wetland will fall as some of the least common or most sensitive native species are eliminated by the spreading loosestrife. The "diversity" of plants in the wetland is said to decline as there are more loosestrife plants, fewer native species, and smaller numbers of the native species remaining in the wetland overall.

As plant diversity declines, the variety of available food for herbivores goes down, the kinds of places for wetland birds to nest declines, and so on. Consequently, the number and types of herbivores and birds and other animals dependent on native plants is reduced and the whole wetland community becomes less diverse. In extreme cases of very low biological diversity a wetland may become a "biological desert" (not unlike the bluegrass lawns around many of our homes). What do you think this expression means?

Biodiversity in a biotic community is a measure of both the number of kinds of organisms, as well as how evenly distributed the importance of each species is in the community. It is a significant ecological concept because a diverse community is thought to be more stable and resistant to degradation in spite of a changing world around it. Why do you think this is important today?

If it is true that purple loosestrife replaces wetland plants, and we have an accurate way of measuring and comparing diversity in wetlands over space or time, students should see a strong negative effect (correlation) of increasing levels of purple loosestrife density on the diversity index. If the expected relationship does not appear, it may not be true, or further research or refinement of techniques or calculations may be necessary.

Activity 3. BEAN BIODIVERSITY *(continued)*

PHOTOS: WISCONSIN WETLANDS ASSOCIATION

Healthy wetlands support diverse plant and animal communities like the ones shown here.

This activity uses a simple, non-biological model to measure diversity by calculating a mathematical diversity index for a group of items. It also allows us to see what happens as one of the items becomes more common in the group and the others less common. This mimics what would happen if purple loosestrife were indeed to replace other plants in a wetland. The number of runs (see procedures) is a measure of both how many different types of organisms there are, as well as the relative numbers of each, for a given number of organisms counted (sample size). The closer the diversity index is to 1, the more diverse the community is. Simply put, the more different kinds of species there are and the more even in number they are, the greater the diversity. Bear in mind that the number of items counted should be similar to be able to compare different communities in either space or time.

Activity 3. BEAN BIODIVERSITY

STUDENT ASSESSMENT

Have students write a lab report stating the problem, a hypothesis, experimental procedures, observations, analysis and conclusions. They should include a discussion of how well the model mimics what can happen in a wetland community as purple loosestrife invades.

EXTENSIONS

Re-work your calculations, excluding purple loosestrife runs (the increasing item) from the numerator of the diversity index. This will give you a measure of the effective diversity of only native plants. Is the resulting diversity index higher or lower than when you included loosestrife? Why? One might argue that this might be a more meaningful measure of plant diversity in native wetlands. Why is this so? Which means of calculating diversity is most meaningful for you? Why?

Sample the diversity in real wetlands. Tie a cord (transect line) to two posts put into the ground 3 meters apart in a wetland. Instead of randomly drawing seeds out of a bag, record the species identity of each plant as it is encountered along (under) the transect line. Calculate the Diversity Index for the wetland. Walk transects at several randomly chosen spots, being sure to use the same number of counted individuals each time. Does each transect give the same index value? Why or why not? Average them for a good overall value. (See also Activity 11. Wetlands on the Mend)

Using the information from the transects or model, determine the percent of each plant species encountered in each wetland by dividing the number of individuals of one species by the total number of individuals counted. This is a Species Diversity Index. Do you think it is more or less precise than the Diversity Index we calculated above? Show your results in a bar graph.

[*] Revised with permission from "The Spice of Life: Assessing Species Diversity" in *Biodiversity, Wetlands, and Biocontrol* and "Annual Wetland Plant Diversity Survey" in *The Purple Loosestrife Project: Cooperator's Handbook*.